Math
T

University of Texas Bulletin
No. 2806: February 8, 1928

Physical &
Applied Sci.
Serials

THE TEXAS MATHEMATICS TEACHERS' BULLETIN

Volume XII, Number 2

LIBRARY
MAR 29 1928
UNIVERSITY OF TORONTO

PUBLISHED BY
THE UNIVERSITY OF TEXAS
AUSTIN

Publications of the University of Texas

Publications Committees:

GENERAL:

FREDERIC DUNCALF
D. G. COOKE
J. L. HENDERSON
H. J. MULLER
G. W. STUMBERG
HAL C WEAVER
A. P. WINSTON

OFFICIAL:

E. J. MATHEWS
W. J. BATTLE
R. A. LAW
F. B. MARSH
C. D. SIMMONS

The University publishes bulletins four times a month, so numbered that the first two digits of the number show the year of issue, the last two the position in the yearly series. (For example, No. 2201 is the first bulletin of the year 1922.) These comprise the official publications of the University, publications on humanistic and scientific subjects, bulletins prepared by the Division of Extension, by the Bureau of Economic Geology, and other bulletins of general educational interest. With the exception of special numbers, any bulletin will be sent to a citizen of Texas free on request. All communications about University publications should be addressed to University Publications, University of Texas, Austin.

UNIVERSITY OF TEXAS PRESS, AUSTIN

University of Texas Bulletin
No. 2806: February 8, 1928

THE TEXAS MATHEMATICS TEACHERS' BULLETIN

Volume XII, Number 2

PUBLISHED BY THE UNIVERSITY FOUR TIMES A MONTH, AND ENTERED AS SECOND-CLASS MATTER AT THE POSTOFFICE AT AUSTIN, TEXAS, UNDER THE ACT OF AUGUST 24, 1912

The benefits of education and of useful knowledge, generally diffused through a community, are essential to the preservation of a free government.

Sam Houston

Cultivated mind is the guardian genius of democracy. . . . It is the only dictator that freemen acknowledge and the only security that freemen desire.

Mirabeau B. Lamar

University of Texas Bulletin
No. 2806: February 8, 1928

THE TEXAS MATHEMATICS TEACHERS' BULLETIN

Volume XII, Number 2

Edited by

C. D. RICE
Associate Professor of Applied Mathematics

and

MARY E. DECHERD
Adjunct Professor of Pure Mathematics

MATHEMATICS STAFF OF THE UNIVERSITY OF TEXAS

P. M. Batchelder
H. Y. Benedict
J. W. Calhoun
C. M. Cleveland
A. E. Cooper
Mary E. Decherd
E. L. Dodd
J. L. Dorroh
H. J. Ettlinger
Helma L. Holmes
Goldie P. Horton
R. G. Luben
R. L. Moore
M. B. Porter
J. H. Roberts
C. D. Rice
J. H. Simester
H. S. Vandiver
G. T. Whyburn

This bulletin is open to the teachers of mathenatics in Texas for the expression of their views. The editors assume no responsibility for statements of facts or opinions in articles not written by them.

CONTENTS

Foreword ..... C. D. Rice 5

Algebra in the Public Schools ..... Dean Charles Puryear 9

The English High School of Boston ..... G. W. Evans 15

Curriculum Problems in the Junior High School ..... W. R. Reeve 19

Preperation of Teachers in the Secondary Schools of Prussia ..... C. A. Noble 32

To the High Schools ..... Editors 39

An Open Letter 41

FOREWORD[1]

C. D. RICE

The modern high school in Texas differs very much from that of twenty-five or thirty years ago. Then there were fewer subjects to be taught and more time was given for thoroughness in those subjects. Then there were eight units affiliated with the University and now there are from fifteen to thirty. The average pupil now knows something of many things but too often not enough of any one thing. The thinning and spreading intellectual effort out over so many fields has weakened the mental grasp of the subjects necessary for college entrance. In those days the average age of a high-school graduate was from 18 to 20 years, now it is nearer 16. The combined effect of the increase of subjects taught and the more immature age of the pupils in the high schools has been to lower the grade of work the student is capable of doing after reaching college. The introduction of vocational subjects and physical culture courses consume a great amount of time given formerly to English, History, and Mathematics. Many electives in our high schools, while useful in giving general information, have no value whatever in preparation for the first year in college. A careful examination will show that in these twenty-five years universities and colleges have not raised their requirements for entrance, nor have they made any attempt to accomplish more in the freshman year. In fact, increasing immaturity and lack of thorough elementary training have made it impossible to accomplish as much. The growing sentiment on the part of the faculties of many high schools that preparation of pupils for life should be stressed rather than preparation of pupils college will continue to affect and ultimately to lower

---

[1]Read in part before the State Teachers' Association, November 25, 1927.

the work in the first year of college. This will be true unless some adjustment is made.

The increasing demand in our high schools for subjects that have little value as a preparation for the first year of college is bringing us nearer to the time when each high school must determine as early as possible those of its students who expect to enter college and those who will leave at the end of the course for some career outside the university. Definite classes should be formed in the last two years for prospective college students who will be given instruction necessary as a foundation for the freshman year. Frequent conferences between teachers and students would be of great value in helping to acquaint the student with the problems and difficulties of the first year of college. With so many electives in our best high schools it is hardly possible that immature students are capable of making, without advice, a wise and proper selection of courses for a foundation for college. Going to college should be a more serious matter with many of our young people. All ground work for the first year in college should be thoroughly mastered and reviewed the last year in high school. It is absolutely wrong to classify during the last two years of high school the future college man with the one who is going out into life at once. They have different aims and purposes and cannot be formed and fashioned in the same mould. In many of the larger high schools the formation of separate classes for prospective college students could be easily made. The teaching force in the smaller ones would have more difficulty in meeting the issue—but even there a way should be found to save from failure a large number of those going to college.

In European countries special classes are formed in secondary schools where those who finish their secondary education may return and study from one to two years longer in order that they may have a more satisfactory career in the university. The added maturity and preparation is necessary for those who expect to do work of high grade. In France vocational and technical work is

given in separate schools and placed under a separate management. Commercial and technical education is controlled by the Minister of Commerce, agricultural education is controlled by the Minister of Agriculture, etc. Thus is avoided the possibility of one interest in the same school overshadowing another, as is the case in the American system which throws all students together and moulds them in the same form.

As an illustration of the evil effects of having one mould for all, attention is called to the plight into which algebra has fallen in many of our high schools. In a majority of cases algebra is studied last in the ninth grade when the student is very immature. What little is learned is purely mechanical, and he has no mastery of the logic or underlying principles involved. If pupils could retain what they learn, the case would not be so serious, but after two or three years they find upon entering college that all algebra is forgotten. During the first week in college they are called on either to use algebra as such or to make some application of it in each day's lesson. If they begin trigonometry, algebraic manipulation is necessary. In analytics they find that the majority of statements are algebraic in form. An utter lack of preparation results in failure of about half the student body. An entirely different result is to be noted in the case of those students who have had algebra during the last year of high school.

For a number of years past, students entering the freshman class in engineering at the University of Texas have shown an increasing difficulty in passing the first elementary course in plane trigonometry. Each year our instructors find that in order to accomplish anything at all, they have to teach more algebra than trigonometry. We find that the main diffirulty is with algebra and not with trigonometry, since the students complaining of the difficulties of the latter have been poorly grounded in the former. We have to explain such simple manipulations as removal of parentheses; transposition of terms from

one side of an equality to the other; the addition of fractions; factoring; exponents; the logic of simple equations, substitution, etc. We finally decided it would be more satisfactory to teach algebra from an algebra text than from a trigonometry book. So this year we began with a six weeks' review of the simplest high-school algebra. At the end of the six weeks' period an examination was given to see who were ready to try trigonometry. Fifty-three per cent failed to pass and were placed in a class to take algebra as a non-credit course. Only a small number of the 53 per cent were saved, but they now know exactly where their difficulty lies and are not groping about without a true knowledge of what is the matter. Incidentally it may be well to state that the English Department of the University has had to proceed this year in a very similar manner.

ALGEBRA IN THE PUBLIC SCHOOLS[1]

DEAN CHARLES PURYEAR

Our system of public school is based upon the assumption that the education of the people is necessary to the success of a democracy. On that theory attendance at school up to a certain age has in many states been made compulsory. If the state is to provide education for all, and even require all to undergo the process, it is obvious that great care should be taken to provide a curriculum suitable to the end in view.

There has been a tendency to put into the curriculum more and more new subjects, the argument being such as the following: Every citizen should know something of the government under which he lives; therefore, civics should be a required subject. As if the citizen could be expected to learn nothing except at school!

The question may well be asked, Has this tendency resulted in so overcrowding the curriculum as to defeat to some extent the main purpose for which the curriculum was devised?

In the competition of subjects for a place in the curriculum there arises in the minds of some people a conflict between subjects that prepare for "life" and those that prepare for college. But how does the work of the secondary school prepare either for life or for college? Upon the answer to that question will depend our attitude toward the curriculum.

In my opinion the object of the curriculum should be, not to impart information on every subject the citizen should know, but to train the mind of the pupil. In the process of his education the pupil should acquire an adequate command of his mother tongue and a store of knowledge of the world in which he lives; he should acquire the power to think clearly; to analyze a problem,

---

[1]Read before the Texas State Teachers' Association, November 25, 1927.

discriminating between the essential and the non-essential elements; to draw logical conclusions, and to express his thoughts clearly. He should be taught how to find what he does not know. He should regard his education not as complete but as just begun. Fortunate is he if he has received an impulse to study that will enable him to carry on through his life.

If that view be accepted, it seems to me that there is no conflict between studies on the basis of preparing for life on the one hand or for college on the other. The curriculum that is good for the one purpose is good for the other.

Now, if algebra is to have a place among the required subjects, we must face the question, Why should algebra be required? And I think teachers of that subject should be in position to answer that question. Without elaborating, I should say: Algebra lies at the foundation of many other branches of mathematics. Mathematics in turn is one of the great fields of human knowledge and is the foundation for many of the other sciences, both pure and applied. The progress of civilization depends largely upon the applications of mathematics. This thought affords a good reason for introducing the pupil to the field of mathematics through algebra.

Again, without going into the question of the transfer of training, it may be said that algebra has a high value as a mental discipline, involving logical reasoning, and clearness of thought and of expression. I believe that members of this section will agree that algebra belongs in the curriculum.

The fact that a discussion of algebra has been given a place on this program indicates the belief on the part of Chairman Howard, that there is room for improvement in the matter of teaching the subject. There is general complaint on the part of the colleges, not only in Texas, but in other states, that students in large numbers fail in the course in college algebra. This is not altogether the fault of the secondary schools. Many such failures are due to such causes as lack of study, inability, and

devotion to extra-curricular activities. Nevertheless, it is true that many students do enter college with little or no knowledge of algebra. At the Agricultural and Mechanical College of Texas, the facts are as follows: The mathematics department has for several years, at the opening of the session, given simple tests to freshmen. I take the liberty of giving the results of such tests for September, 1923. The tests involved:

(a) The fundamental operations of addition, subtraction, multiplication, and division of common and decimal fractions.

(b) The fundamental operations of elementary algebra, covering, perhaps, the equivalent of one unit of the two required for admission.

(c) The solution of an easy quadratic.

The tests were as follows:

TEST A (Arithmetic), 10 Minutes

Perform the indicated operations:

(1) $5\frac{3}{4}-2\frac{5}{6}$

(2) $2\frac{1}{3}\times 3\frac{2}{5}$

(3) $2.2+15.036+0.207+13.24$

(4) 3.26×2.003

The number of students who took this test was 645. Question 1 was answered incorrectly by 136; question 2, by 162; question 3, by 165; question 4, by 140. For the test as a whole 102, or 13 per cent, received grades below the passing mark.

The operations involved in the test are those that are learned in the lower grades; once learned, they should never be forgotten.

TEST B (Algebra), 45 Minutes

1

(1) Multiply $2a^2-5a+7$ by $5a-6$

(2) Factor $x^2+11x+24$

(3) Simplify $\frac{4a-23b}{4}-\frac{4a-25b}{6}-\frac{19b-3a}{12}$

(4) Simplify $\dfrac{x^2+y^2}{x^2-y^2} \div \dfrac{3x^2+3y^2}{x+y}$

(5) Simplify $\dfrac{\dfrac{1}{x}+\dfrac{4}{x^2}+\dfrac{4}{x^3}}{2+\dfrac{5}{x}+\dfrac{6}{x^2}}$

(6) Solve $\dfrac{4x-1}{3}-\dfrac{3}{4}=\dfrac{x-4}{6}+\dfrac{3x+5}{4}$

(7) Solve simultaneously $2x-3y=3$; $5x+7y=109$

(8) Simplify $(3a^2x^3)^4$

(9) Simplify $2\sqrt{50a^2c}$

(10) Express without negative exponents $3ab^{-2}c^{-1}$

This test was taken by 518 students. Only 14 per cent received a passing mark.

TEST C (Quadratic Equation), 15 Minutes

Solve: $5x^2+9x-2=0$

In every case the quadratic was so chosen as to give rational roots.

The test was taken by 640 students. Only 25 per cent received a passing grade; 365 made a flat 0.

It will be noted that on Test A 16 per cent fell below the passing mark; on Test B, 85 per cent; on Test C, 75 per cent.

I realize that these tests were given just at the end of vacation and that most of the boys had not thought seriously of books for several months; further that a period of two years had elapsed since they studied algebra in school. Nevertheless the showing is poor.

Similar tests were given in subsequent years, with approximately the same results.

I believe that, after making all proper allowances, you will agree that this is a poor showing.

To meet this situation, we have followed the University of Texas this year in providing a non-credit course in

algebra and transferring to it students who by November 1 show that they are unprepared to do the work of the college course in algebra. Out of 828 students in college algebra, 82 were required this year to drop that subject and to take the non-credit course.

But the main purpose in bringing up this subject was, I take it, to bring out constructive suggestions for the improvement of the teaching of algebra in secondary schools.

Confessing that I am not in close touch with the work of such schools, I respectfully submit the following:

(1) Insist, throughout the course, on thoroughness and accuracy, reducing, if necessary, the extent of the course.

(2) Insist on a mastery of the fundamental operations of addition, subtraction, multiplication, and division, both for whole numbers and for fractions.

(3) For the first year at least, forbid the use of the words *cancel, transpose, cross multiply* and of the double sign $\pm$.

(4) Give a thorough drill on the laws of exponents in the case of integral exponents; then teach the student that the same law holds for fractional and negative exponents, illustrating fully with monomials with easy exponents such as $\frac{1}{2}$, -3, etc. To the brighter pupils, the reason for this fact may be explained; for the others, let the fact suffice.

(5) Be sure that the pupil knows what is meant by a *root* of an equation, and by a *solution* of a pair of simultaneous equations.

(6) Insist that the solution of a pair of simultaneous equations be written in form $\begin{matrix} x= \\ y= \end{matrix}$ and give ample practice in checking solutions.

(7) Require the pupil to understand and to memorize the rule: "To clear an equation of fractions, multiply each member by the lowest common multiple of the denominator."

(8) Teach three ways of solving a quadratic of the typical form $ax^2+bx+c=0$

(a) by completing the square
(b) by the formula
(c) by factoring.

(9) In the matter of the square root of polynomials, teach the "how" of the process, not stressing the "why."

(10) Do not pass a student who does not deserve it. I am told that this is sometimes done under pressure.

(11) *Omit:* "Multiplication and division of polynomials having fractions, negative or literal exponents; the Euclidian method of finding the highest common factor and the least common multiple,"[2] cube root, inequalities, series, binomial theorem, when the exponent is not a positive integer.

These suggestions or recommendations are in substantial agreement with the ideas well expressed in Bulletin No. 196 of the State Department of Education, pages 53, 54. The statements found on these pages should be carefully noted by teachers of algebra.

Finally, I suggest that algebra be transferred from the eighth and ninth years to the ninth and tenth. Many students drop out of school during the eighth and ninth years. Many of them have no aptitude for algebra. Such pupils would be relieved of one or two years of work in algebra and but little would be lost thereby. Again, the pupil who goes on to college would be fresher on his algebra upon entering college. I realize the difficulty of making such a change in the curriculum, but I believe it is worth considering.

---

[2]Bulletin No. 196, State Department of Education.

THE ENGLISH HIGH SCHOOL OF BOSTON

G. W. Evans

The English High School in Boston was founded in 1821. It was for the education of boys not destined for college, the first public school in this country if not in the world to fit them for active life and "to serve as a foundation for eminence" in mercantile or mechanical occupations. The subjects of instruction from the beginning included algebra and geometry and natural science. Four of the five men who presided over the school in the first sixty years of its life had been college teachers of mathematics, and it is probably due to the fact that a tradition of thoroughness in that subject has characterized the school down to this day.

When the Massachusetts Institute of Technology was established in the seventies, it was soon found that graduates of this school were adequately prepared for entrance. In the nineties, when Greek ceased to be insisted on for college preparation, a four-year course enabled the school to present its graduates there. Thus was added to the original function the preparation of boys for college; but in undertaking that task it was stoutly determined that teaching should continue to be of the subject for its own sake, for completeness of instruction and for competence in its application, and not with an eye to the questions that an examiner might ask.

Following is the course of study in mathematics that was formulated thirty years ago, and has since been maintained:

MATHEMATICS (M)

M1. First Year. (A required subject in all courses in Grade IX.) Algebra applied to the explanation of problems in arithmetic, to the abbreviations of rules, and to the statement and proof of theorems; the fundamental transformations; factors and factorable equations;

solutions of quadratics by factoring, and of problems involving quadratics; elimination in equations of the first and second degrees; fractional equations. *Five periods, five points.*

M2. Second Year. Algebra continued; fractions, proportions, and variation; literal equations; indices, surds, and roots. Plane geometry; demonstration of about eighty theorems, and study of models in formal demonstration; the devising of original constructions and demonstrations; the solution of numerical problems, and the use of algebra as an aid thereto. *Five periods, five points.*

M3. Third Year. Plane geometry reviewed; original demonstrations; solid geometry, with applications to mensuration involving the use of algebra. A grade of *A* or *B* in M3 certifies for college in both plane and solid geometry. *Five periods, five points.*

M4. Fourth Year. Algebra reviewed; the progressions and the binomial theorem; theory and use of logarithms; trigonometry, including the solution of plane triangles, the demonstration of standard formulæ, and their application to the establishment of identities and to the solution of equations of condition; the simpler applications of trigonometry to surveying and navigation. A grade of *A* or *B* in M4 certifies for college in both algebra and trigonometry. *Five periods, five points.*

In 1874, when I who write this entered the school as a pupil, the headmaster was Edwin P. Seaver; he had been a professor of mathematics in Harvard College. The teacher to whom I was assigned was C. O. Whitman, afterwards a famous biologist. He taught for years in that distinguished group that built up the Imperial University at Tokio, and left there to become one of the stars in the crown of Chicago. All my classmates were boys and all the teachers were men. It had always been so, and it is so today.

The teachers took it for granted that the boys were there to learn what they could. Moral delinquency or a deliberate defiance of authority was a serious matter—all the more serious because it was unlooked for. Public opinion was against it. Not only did the teachers deserve and expect the deference naturally due to men of high standing in the community, but they treated the pupils as men out of school would treat them—more as college students are now considered than as schoolboys. There was no fussing with rules and standard penalties. This

tradition of manliness had its origin in the character of the men whom the school was fortunate to secure in succession throughout the years of its early growth, and was by this time so firmly implanted to be a permanent characteristic.

In 1885 I returned to the school as a teacher. It is my pride that I had served it for twenty years as a teacher of mathematics. Among my colleagues half had been my teachers, and of the others there was a small group young enough to become lifelong friends—men of scholarship, and of character rare in any profession. School affairs were discussed as in a senate by the whole teaching body. In this discussion and in individual consultation the ideals of the school were assumed, not preached, and the standards of the school were held to as soldiers hold to the traditions of a famous regiment. The occasional quack was overruled or ignored.

The first year of a pupil's membership in the school was regarded as of the greatest importance. A principal aim of instruction was that he should acquire a critical attitude toward his own work, feeling responsible to himself rather than waiting for and depending upon the teacher's verdict. In algebra, which constituted the first year mathematics, the equation appeared at the start as a means of dealing with problems stated in words, and knowledge of the manipulation of equations progressed as the problems increased in complication. Three textbooks, written in three succeeding generations by headmasters or teachers of the school, carried forward this plan and in other ways emphasized the trend from mere formalism to sound thought. More than one of the progressive features of teaching now becoming popular made its beginning in these forgotten books. Comprehension was the aim, rather than mechanical facility. Graduates entering college had therefore the reputation of holding their place in mathematics better than many who had surpassed them in admission examinations. Teachers who came with a scornful eye for the parochial dogmas of the school became enthusiastic converts. Lately one of these young

disciples was drafted for a great preparatory school, to preach from a high place the gospel of common sense.

This way of beginning mathematics, and the absence throughout of any sort of buncombe or mere cramming, probably account for the fact that when the elective sys-system was imposed upon the school the membership of classes in this subject continued to be large. They include at present nearly two thousand of the 2,800 pupils in the entire school; in the fourth-year mathematics, which surpasses the ordinary college requirement and presupposes three years of algebra and plane and solid geometry, fully a third of the graduating class are enrolled. Some of these, of course, are going to college; but probably half have no such intention.

Of the graduates that do go to college there is a record of success in modern languages, in science, in mathematics, and in English. It is gratifying to think that the group of mathematics teachers contributed to the reputation of the school in English, as well as in their own subject, by insisting on clearness and precision and brevity in all written or spoken work. The teachers of science did likewise; and the teachers of French and German and Latin have always done their part by requiring that every translation should express the ideas of the author in the idioms of the translator. There was no rule about these things for authorities to enforce. It was the way the school had always done it, and nobody was willing to let the standard fall.

On January 25, 1928, there was unveiled in the English High School a monumental bronze group, the costly gift of a grateful son. The sculptor is Daniel Chester French. It embodies his conception of the spirit that animates the school and perpetuates its memories and aspirations. It is the graceful and enduring emblem of a noble tradition.

CURRICULUM PROBLEMS IN JUNIOR HIGH-SCHOOL MATHEMATICS

WILLIAM DAVID REEVE

Professor of Mathematics, Teachers College

The human material with which we deal in the seventh, eighth, and ninth grades of the junior high school is very different from that of the corresponding grades thirty or more years ago. Not only is this true, but they differ more widely among themselves than did their predecessors in native ability, experience, and interests.

A generation ago the great central objective of the high school was to get pupils ready for college. Today the central aim is to develop well-educated citizens. These changes in the nature of the high-school population and in the great central purpose of American education have brought about a need for changes in the more specific objectives in teaching particular subjects like mathematics. In many schools today we are developing neither scholars nor well-educated citizens. The thoughtful teacher realizes the need for adjustments to meet the demands of the times. The "humdrum" teacher is content to let things remain as they are.

In the junior high school the course in mathematics has been better organized than of any other subject, but it has been too much a shoving down of the traditional material from the senior high-school field. One needs only to examine a few of the many series of mathematics texts to see that this is true. As a result the senior high-school teachers object to the teaching of certain topics like demonstrative geometry in the junior high school because they feel that such teaching will spoil the pupils for the later work in the same subject in the senior high school.

We must approach the final solution of the problem as scientifically as possible. The organization of the curriculum should be fundamental and more psychological

than the traditional course. In order to do this there are certain important steps in curriculum building which must be kept in mind.

In the first place, we must find out what mathematics is worth learning as far as the well-educated citizen is concerned. This involves the setting up of valid objectives to be obtained in teaching the subject. The second step is to determine the nature and the extent of the content material which will best enable teachers to realize these objectives. In the third place, we need to study our methods of teaching and learning. We know a great deal about the former, but practically nothing about the latter. Teachers ought to know more about how pupils learn most easily and most economically. Today we do not know how long it takes to teach anything. Granted that the objectives chosen are valid, that the content material selected is best suited to realize these aims, and that our methods of teaching are satisfactory, we still need to find out what part of the content material can be learned by a pupil at a given age. It is probable that we are trying to teach too much or that we are attempting to teach things tnat are too difficult, or both. The fourth step is to provide a testing program that will enable us to find out how well certain fundamental aims have been realized, if at all.

Such procedure means that curriculum construction will be dynamic, that a curriculum committee will be a standing committee. We ought to be constructively critical of our content and methods at all times. This is just the place where we have failed in the past, because in regard to content at least, certain parts of traditional material have remained unchanged for over two thousand years. One would hardly dare to express an opinion as to the age of certain matters of technique.

What has been said above is no apriori argument against any of the time-honored content material or methods of presentation that can be justified on any rational basis. The fact that any topic or method has stood the test for ages, is some reason for respecting both,

but it does not mean that age alone gives the topic or method precedence over any other, or that it should become sacred. Professor Nutt says[1] "Teachers and supervisors are inclined to think in terms of the subject instead of in terms of the student. Subject matter has been standardized instead of stages of mental maturity of students. The teacher and the supervisor have been dealing with the subject so long that it has become a familiar acquaintance; hence it has become more or less a sacred thing. The subject has become a habit with them; it is regarded as something permanent and abiding; hence to leave out any of the sacred facts seems almost sacrilegious and criminal. On the other hand the student is transient. Students come and students go; hence to leave the student out is justifiable. In fact, leaving the student out may be getting rid of an unappreciative butcher who haggles and mangles the sacred subject most horribly in his attempts to find food for mental maturing. The relief that is usually manifested by teachers and supervisors when the student, who is not getting on, drops out is a definite indication that the subject is more important to them than is the student. Whenever teachers and supervisors begin talking about education by means of the subject 'getting on' in the student instead of the student 'getting on' in the subject, then a radical change will come about in the teaching in secondary schools."

It is evident that no satisfactory list of objectives can be set up merely by consulting existing courses of study only. While they may be used as evidence of what is being taught throughout the country they do not often give much help in suggesting what ought to be taught. Moreover, it is well known that some of these courses, if not all, tend to perpetuate certain obsolete processes and antiquated business methods.

It is equally true that the best objectives cannot be secured by making an inventory of the current textbooks in

---

[1]Nutt, H. W., *The Supervision of Instruction*, p. 53. Houghton Mifflin, 1920.

mathematics. In most schools they are the courses of study. They, too, are frequently guilty of overemphasizing unimportant or obsolete material. It is also true that not all textbook writers are able to suggest newer and better things. Often their books are made to conform exactly to certain state syllabi or other courses of study.

The standardized test makers of recent years have erred in including in their tests exercises and problems that thoughtful teachers everywhese have no desire to see perpetuated in our schools. In fact many of these undesirable elements were obtained by the makers of tests from existing courses of study and textbooks. Thus, it is obvious that such tests cannot be used as the sole basis for determining a list of desirable objectives.

We also know that it is not safe to try to determine what mathematics ought to be taught by counting the frequency with which certain mathematical terms are used in a few current editions of newspapers and magazines, although some writers have seemed to believe that such procedure is valid.

Finally, it is fair to say that we cannot determine our objectives by going out in the world and asking Tom, Dick, and Harry what mathematics is useful to them. The fact is that not one of them ever knows just what use he has made of mathematics. Moreover, they probably have given no thought to the question of determining how they might have used mathematics profitably if they had only thought about it a little while.

Any and all of the above criteria may be of service to us in making out lists of desirable objectives, but they will not suffice. If the objectives set up are to meet our modern needs, we must have at least one other criteria that is supported by vision though it should not be visionary. This last criteria is the opinion of expert teachers of mathematics—those who are able not only to tell how they use mathematics, but also to show how mathematics may be used in the present and in the future for the betterment of mankind.

When people have to consult with experts they usually get the opinion of the best they can afford or find. The writer has had the assistance of such a group of experts in setting up a list of objectives[2] in mathematics for the junior high school, but the list is too long to include here.

If all the children of all the people are coming to high school, and it should be possible for every normal American boy and girl to do so, two things ought to be accomplished. First, the boys and girls should be given an opportunity to learn more about mathematics than their ancestors knew. The modal or common amount of mathematics actually learned by the ordinary American youth is not half what he ought to be able to appreciate if only we were alert in waking up to our possibilities. For some we shall have to make the content simpler and less formal. We shall have to teach them not so much mathematics, but more about mathematics. They can't all be of the research type. For some who like the subject and who have the ability to pursue it further, we ought to provide a course that will at least include everything up to and including the fundamental ideas of the Calculus by the end of the senior high school. Mathematics has played an important part in the development of human affairs and it is perfectly clear that it will continue to do so. To be truly educated one should have some idea of the rôle mathematics has played in human progress, and to appreciate as fully as possible its power and its beauty as a science. All of this means that our elementary courses should cover as broad a range of mathematical ideas and processes as possible. This is why the Calculus should not be left out. It need not be left out if we are careful to omit some of the "dead wood" from our courses. Such a scheme takes into consideration both the necessity for a happy and more intelligent followership and the right type of leadership. The trouble with our tnaditional scheme is that it makes our brilliant students the most

---

[2]Smith, D. E., and Reeve, W. D., *The Teaching of Junior High School Mathematics*, chap. 111. Ginn, 1926.

retarded of all. Our educational machine is geared up so as to turn out a product that is mediocre.

To continue traditional organization of content and method means to continue the practice of failing large numbers of pupils instead of trying to give them a course with which they can succeed. Nobody can justify the large percentage of failures that we find in algebra in so many schools. It is a bad thing for any child to fail. The loss to mathematics itself and to the children who fail is far greater than we realize. Many a student has been marked "failed" when he really has succeeded in the best sense of the term. So much depends upon what we expect of him and upon what he really can do.

As Professor Nunn[3] has so well pointed out "mathematical truths always have two sides or aspects. With the one they face and have contact with the world of outer realities lying in time and space. With the other they face and have relations with one another." The first he illustrates by saying that one is enabled to determine by scale drawing or by calculation the height of an unscalable mountain peak twenty miles away from the fact that equilateral triangles have proportional sides. While on the other hand, the truth itself can be deduced with complete certainty from the assumed properties of congruent triangles.

According to Professor Nunn our main objective should be to make the children realize, in an elementary way at first, this two-fold aspect of the growth and development of mathematics. How can we plan our courses so that we may realize most fully such an objective? In the first place, it seems to me that we should not plan separately for the two aspects, the practical and the theoretical, in the curriculum. Let us therefore try to choose hypothetically as the most desirable and important that theoretical content which is at the same time the content which arises naturally out of the child's attempts to apply his mathematical ideas and methods to practical ends in

[3]Nunn, T. P., *The Teaching of Algebra*, p. 16. Longmans, 1927.

his daily life. And by "practical" I do not imply the narrow use of the term which is so often misleading.

If we can have agreement on this last point, then we are compelled to select as a basis for theoretical discussion those topics in mathematics in which the practical value of the content material is most clearly represented. This is not an easy task because it is not always easy to get general agreement as to what things are practical. Moreover it is well to remember that in actual classroom practice we should not only try to conserve the things which are certain to be practical or even contingently so, but to eliminate from the course such material as is impractical if not impossible or obsolete. Such reorganization alone, if honestly carried out years ago by teachers of mathematics, would have made the lives of many children much happier as well as more valuable.

In line with our purpose we should place more emphasis upon a clearer understanding of fundamental concepts and methods of thinking and less on the pure algebraic technique and ease of doing mechanical processes. It is doubtful whether the automatic application of principles develops anything that can be considered of general educational worth in itself. This does not mean that we should not develop skill in the manipulation of algebraic processes, but only to the extent that certain matters of mathematical thinking may be understood. I say this because a great majority of our high-school students do not continue the study of mathematics beyond the ninth or tenth grades at best. And even for those who continue because they like mathematics, or expect to need it, greater power for future work will be gained if the time is spent in giving them insight and appreciation rather than mere emphasis on manipulation.

In the first place, it is pretty well agreed that the majority of students will never have occasion to use the skill they acquire and hence had better spend the time to better advantage. We ought to determine just what these skills are that need not be highly developed and also to determine those skills that all will need to have developed

for later use and dwell only on these for complete mastery. Again our conventional methods have delayed the teaching of many interesting and valuable things in the elementary and secondary schools. The English and continental schools of Europe are far in advance of us in the way they have organized their courses in mathematics.

Very few adults in this country ever get any opportunity in high school to obtain any idea of space relations through a study of space geometry. Every normal child should obtain some of the fundamental ideas of solid geometry although much of what has traditionally been taught should be omitted. It seems perfectly clear at this time that the conventional tenth-year course in geometry will soon become a combined course in plane and solid geometry where the general mathematics course is not adopted. It seems unintelligent to live in a world of three dimensions and teach the geometry of Flatland.

The elementary ideas of trigonometry, in many respects very simple, have been omitted altogether from the mathematics work of most secondary schools. Much of this work is not only easier for an ordinary ninth-grade pupil as many topics in algebra, but it far more interesting and more valuable. Besides trigonometry gives us better than any other subject an idea of our "infinitesimal nature" in the midst of space about us.

What harm can come from omitting a great deal of the material that we have been teaching in arithmetic, algebra, and geometry, and taking for granted a great deal more that we have been forced to try to prove with little or no success? The old-fashioned geometrical method of proving the Pylliagorean Theorem can be replaced by a simpler and shorter algebraic method known to every competent teacher.

Taking the country as a whole, the teachers of junior high-school mathematics have made greater progress in solving the problems connected with their part of the curriculum in mathematics than have the senior high-school teachers in their field. There are several reasons

why one is justified in making such a statement. In the first place, some of the junior high-school teachers are better teachers, even though their knowledge of advanced mathematics is meager. Perhaps this is because so many of them have been recruited from the ranks of the teachers in the elementary school, many of whom are graduates of our best normal schools and colleges. Secondly, some of them understand child psychology better and have had more experience and training along this line. In the third place, they have not been so hampered by tradition in organizing a course of study for the seventh, eighth, and ninth grades. This has enabled them to be more progressive and experimental in their methods in trying to find out the best material to include in each grade. Again, they do not have to prepare their pupils to meet extramural examinations and hence are not obliged to point all of their work toward one final test, thus becoming formal and wooden in their methods.

The result of the combined efforts of all those interested in the teaching of junior high-school mathematics has had a salutory effect. We have today a rather wide agreement as to the general features of the course in junior high-school mathematics, even though the order of treatment of topics is not standardizd as it has been in the senior high school. Thus it is quite generally agreed now that the course in mathematics in the junior high school should be determined by the general purpose stated previously, namely, to develop well-educated citizens.

This difference in purpose makes a difference in content possible. It permits us to open the door of mathematics to every boy and girl so as to give a broad view of the subject in order that each one can choose according to his ability and preference, having seen the general nature of the subject and what the science means. If his taste and needs require it, the pupil should be permitted and encouraged to go on. If not he should not be forced to continue the study too long.

Because of the wide range of individual difference in native ability, experience, and interests, we need to keep

in mind the guiding principle in the selection of subject matter for each grade. This principle states that the subject matter selected should be that material which will be most valuable to the pupil provided he leaves school at the end of that year. In accordance with this principle the aim in the seventh grade should be to keep up a proper use of the fundamental skills in arithmetic which the pupil has learned in the first six grades. This is done by giving such applications in the arithmetic of the home, of the store, of the bank, of thrift, and the like as the well-educated citizen is likely to need. In addition, the pupil is introduced to the study of intuitive geometry, a subject in which he looks at a figure and draws certain conclusions. For example, he looks at an isosceles triangle and says "the base angles are equal" because he cannot conceive of their being otherwise. In other words, "he feels it in his bones."

There are three questions in geometrry which may be asked about an object. First, "Where is it?" Second, "What is its shape?" Third, "What is its size?" The answers to these questions give rise to the geometry of position, form, and size. These topics should be treated in such a way as to give the pupil some idea of geometric forms in nature, architecture, design, and the like.

Under the head of the geometry of size the pupil is introduced to simple problems of direct measurement and thus is led to understand simple algebraic formulas like

$$c = \pi d, \quad A = \pi r^2, \quad d = rt$$

and the like. The need for a knowledge of evaluation of these simple formulas leads to such equations as

$$3l = 12, \quad n+4 = 10, \quad c-s = 14, \quad \text{and} \quad \frac{b}{2} = 6$$

whose solutions can easily be presented in the seventh grade.

In the eighth grade a little more than one-half of a pupil's time should be given to a further consideration of intuitive geometry and to the fundamental applications of arithmetic, such as problems of trade, banking, insurance, corporations, and the like. The remainder of the

year should be given over to a study of algebra. It is better to continue the study of algebra which was begun in the seventh grade and finish it in the ninth year rather than to condense the treatment all in the ninth grade.

If a pupil ever uses algebra at all, his greatest need will be a knowledge of the formula. Here is where he gets his idea of what algebra means. Even if he doesn't use formulas, he must read with them. And so it is with the statistical and the mathematical graph. Moreover, if the pupil uses formulas at all, he will need to know how to solve the simpler types of equations. To these three important ideas we may add directed numbers as the fourth thing in algebra which the well-educated citizen should know.

In the ninth grade the course in elementary algebra should be completed and a unit of numerical trigonometry given. There is no question that intuitive geometry correlates well with both algebra and trigonometry. This can easily be done because the trigonometry is based on intuitive geometry and the pupil's previous knowledge of algebra. Moreover, there is today a clearer conception than formerly of the nature of trigonometry and its relation to modern life. It gives the pupil a knowledge of indirect measurement in contrast to direct measurement where the measuring instrument is laid directly on the distance to be measured. It can be made so simple as to be much easier than many of the traditional algebraic topics, it is far more important, and it is more interesting to the pupils.

A short course in demonstrative geometry should be given so that the pupil will have a chance to find out what it means to prove something. This can be done with a few axioms, postulates, and theorems reinforced by some carefully planned work on original exercise.

It is clear that the junior high-school course briefly described above is general mathematics in the best sense. With this basis it is possible in the tenth, eleventh, and twelfth years to give a glimpse into the more advanced

parts of geometry, trigonometry, algebra, analytic geometry and the Calculus to those pupils who are able and interested enough to study further.

I have mentioned all of the various departments of the field of mathematics in some detail, because I want to emphasize at this time the importance of a requiring that a teacher of mathematics in the junior high school be well grounded in subject matter.

A reasonable and a desirable requirement which ought to be met by every one wishing to teach mathematics in the junior high school would be just such a course as I have described above culminating in the Calculus. Of course no one will teach calculus in the junior high school, but he will teach the other material better if he knows what lies ahead. In other words, a teacher should know his subject as thoroughly as possible in order to have the proper background for his work. This is the first step in his preparation. In no other way can he be qualified to determine valid objectives.

In the second place, the teacher of the junior high-school mathematics should be well trained in methods of teaching. This involves a knowledge of the various types of lessons, lesson planning, the art of questioning, and the like. It is clear that with all the success teachers in the junior high school have there is still room for improvement in methods.

In the next place, teachers should be encouraged to attend regularly the associations of mathematics teachers to which they should rightfully belong, to read the mathematics journals and yearbooks, and, occasionally to spend a few weeks in school to strengthen and renew their interest in mathematics. Nothing is of any more importance today in connection with the improvement of the curriculum than the training of teachers in service. It is sheer folly to spend a great deal of time reorganizing the curriculum unless the teachers of mathematics at the same time keep pace with the changes that are being made around them.

Implicit in all that I have said is the great need for better organization and understanding among mbathematics teachers as a group. The junior high-school teachers occupy an enviable position between the teachers of elementary arithmetic on the one hand, and the senior high-school teachers on the other. Each group needs to know what the other groups are doing. All these groups should be represented and kept vitally interested in any organized study of curriculum problems. Today this is not the case. There is too much apathy and neglect of these important connections.

Finally, there is the need for wise and adequate supervision. Someone ought to discover what a supervisor does when he supervises. We have had a great deal of discussion of late about supervising, but very little real supervising is done. We need to spend less time on some of the mechanical and physical phases of school work and more on the ways of improving instruction.

It is only by the coöperation of all concerned from the superintendent of schools through the principal and supervisor on down the list to the humble classroom teacher that we may expect to achieve the great aim of the American public school system.

PREPARATION OF TEACHERS IN THE SECONDARY SCHOOLS OF PRUSSIA

C. A. NOBLE

University of California

(1) The prospective teacher must have graduated from a nine-year secondary school in Prussia, or have had equivalent training. This is in general fully, in some respects more than the equivalent of the first two years at an American university.

(2) The prospective teacher must have passed the state examination (wissenschaftliche Pruefung) set for candidates for a teaching position. The examination must be in two major subjects, one minor subject, and in philosophy. The examination is held by a committee composed of university professors and schoolmen. To qualify for admission to this examination the candidate must have studied at least eight semesters at a university, of which at least six must have been at a German, and at least three at a Prussian university. He must submit evidence that the studies in the major have included the appropriate laboratory and seminary courses and that for two semesters he had gymnasium practice two hours a week, under the direction of the university teacher of games and gymnasium practice, and that during an equal period, he heard, for two hours a week, university lectures on physical training.

The majors and minors must be chosen from the following group: Christian religion, ancient classical languages, German, French, English, history, physical geography (Erdkunde), mathematics, physics, chemistry, botany, zoology. There is a considerable list of supplementary subjects from which a "Zusatzfach" may be chosen in place of a minor. It includes various modern languages, drawing, singing, "Turnen," pedagogy, and several natural sciences. The examination in drawing, singing, and Turnen is given by a special body.

The examination consists of a written and oral part. *Written part:* The candidate is given two subjects upon which he must submit papers, one from the field of that major to which he has given the more attention; the other either from the field of his other major or from philosophy, as he prefers. He is allowed five months in which to prepare these papers—three for the first and two for the second. The examiners may, at their discretion, subject the candidate to a written test, lasting not to exceed three hours, in all his subjects.

Oral part: The candidate is examined orally, in each of his subjects, by an appropriate member of the examining committee. In addition to this examining member, there must be present at each such examination another member, representing that subject or a related one, who keeps a written record of the progress of the examination. In some subjects, but not in mathematics, the subject examination is divided into two parts, at the discretion of the chairman of the committee. In the case of unrelated subjects, such as English and French, or religion and mathematics, the dates of the oral tests are separated by an appropriate interval, to avoid undue hardship for the candidate; but all the oral examinations must fall within one week.

(3) The prospective teacher must have spent, after passing the state examination, two years in practice preparation, for which he is assigned to a secondary school recognized for that purpose, and during which he is under the guidance of experienced secondary school teachers. The training is under the control of the provincial school board (Provinzialschulkollegium). To be enrolled for this practice training course the candidate must supply:

(a) A certificate showing that he has passed the state examination.

(b) A certificate showing that he has the requisite health; in particular, that he is free from tendency to chronic disorders and from disturbances of speech; and that sight and hearing are good.

(c) Evidence that he has the means to support himself during the two years. Assistance is supplied in exceptional cases, determined by the board or by the minister of culture.

Upon approval of his application, the candidate is assigned to a secondary school and placed under the guidance of a capable teacher of his subject, who, together with the principal of the school, is responsible for his year of training, to another school. The first training year may be spent at a six-year school, but the second must be at a full, *i.e.*, a nine-year secondary school.

During the entire two years the candidate, who now has the title "Studienreferendar," must have weekly conferences (at least two hours) with his teacher-guide. The subjects of conference must include the historical development of education; the nature and administration of education in Prussia; the theory of instruction in those subjects in which the candidate is trained, and the handling of written classwork in these subjects; theory of instruction in those subjects which are of primary importance in all secondary schools, viz. religion, German, and history; the preparing of sample lessons to be given by the candidate, and his observing of lessons given by teachers of the school; psychology and ethics of educational questions; sex-knowledge and sex-pedagogy; mental disorders of youth; principles of discipline applied to current happenings; care of health and physical development; functions of a class teacher; relations between school and home; educational literature. During the conferences the candidate is required to discuss the above subjects to the end of widening his point of view and of improving his power of oral presentation. From time to time, at least once each semester, the candidate must submit a carefully prepared paper on one of these subjects. These papers are judged by the principal and the guiding teacher, both as to content and expression.

Each candidate keeps a brief diary of his experiences and submits it to the principal once every three months.

The candidate is expected, during the entire two years, to extend his knowledge of his chosen field.

It is the duty of the teacher-guide to train the candidate (he has usually two, at most three, assigned to him) in the actual handling of classes. To this end he instructs them in methods and didactic principles of class instruction in the candidates' subject, and turns over to the candidate the actual conduct of instruction under his own supervision, occasionally at first, but with increasing frequency as the candidate acquires confidence and shows capacity. He enjoins upon the candidate the importance of understanding and sympathy with the pupil, especially the weaker pupil. After the candidate has acquired proficiency, he is given, for a half year the instructing, in his subject, of one class in the school. He is required to submit to the teacher-guide, in advance, a plan for this instruction, showing the distribution of material. The guide visits the class from time to time and criticizes the candidate's work (not in the presence of the class).

After the first half year, and at least every four weeks thereafter, the candidate is required to give a sample lesson, at which the principal, the teacher-guide, and all the other candidates are present. The candidate submits beforehand his plan for the lesson. At the conclusion of the hour the teachers and candidates confer over the conduct of the lesson. Good and bad points are noted in the candidate's method of instruction and his bearing before the class.

Candidates are directed by the principal, especially during the second year, to visit the classes of teachers other than the teacher-guide, and in subjects other than that of the candidate; and, where circumstances permit, to visit other schools and institutions. They are directed also to become acquainted with all the functions of the school library, laboratories, collections, administrative apparatus, and methods; to take part in the school celebrations and excursions; to show interest in the physical exercise, games, and class meetings; and to attend examinations.

After the first half-year candidates may be used, in emergency cases, as substitute teachers in the school, for a limited number of hours.

(4) The prospective teacher must pass the pedagogy examination (Paedagogische Pruefung). To qualify for admission to this examination the candidate must have a favorable report from the principal and the teacher-guide on his work during the two practice years. This recommendation must be based upon his exhibited capacity for teaching; his knowledge of his subject and the earnestness of his efforts to extend it; his health; his social behavior.

The examination is held by a committee composed of a member of the provincial school board and of three others, who are principals or teachers in the schools of the province. The minister of culture may send a representative, who acts as a fifth member. The examination consists of three parts:

Written part: The candidate must prepare a thesis on a topic selected by himself or assigned to him, from the theory of education. This paper should exhibit his own views on the subject, gained from his experience during the two practice years and supported by scientific argument. This paper must be submitted three months before the close of the second practice year.

Test lessons (Lehrprobe): The candidate must give two actual class lessons before the committee. The topics in which the exhibition teaching is to be done are assigned to the candidate forty-eight hours before the lessons are given. In advance of the lessons he must submit his plan.

Oral part: The candidate is questioned orally by the committee to test his understanding and grasp of the problems that have been his concern during the two practice years.

From the moment when the candidate is accepted by the provincial school board and assigned to a secondary school for training he is officially in the service of the state and bears the title *Studienreferendar*. After the

passes the pedagogy examination, he is listed for appointment as a teacher and is called *Studienassessor*. When he receives appointment as a teacher, he becomes *Studienrat*.

In Berlin and Stuttgart I had the good fortune to be present at a trial lesson (Probelektion). The procedure was, in all essentials, the same in both. The candidate had submitted to the principal, in advance, the plan for the lesson. It seemed to me a severe test of the novice's composure, to carry on class instruction for an hour in the presence of the principal, the teacher-guide, and several other candidates, all of whom were watchful critics. In both cases the student-teacher performed in a creditable way, showing tact in the handling of pupils, presence of mind and resourcefulness in the face of difficulties. At the close of the hour the trial-teacher and the critics adjourned to the conference room for discussion of the test. The candidate was given an opportunity to criticise his own performance, to say in how far he had succeeded in carrying out his plan, and how that plan might have been improved. Criticisms then followed by the other candidates, the teacher-guide, and the principal. While the conference was fairly formal and the criticisms frank, yet it was held in an atmosphere of kindly helpfulness and the candidate seemed to feel that he was getting friendly coöperation.

In Hamburg I visited two schools to which candidates had been assigned for training, but in both cases the candidates were on detail for regular teaching in the city schools because of a shortage of teachers.

There is no provision at the universities and technical schools for future teachers of science to acquire, in the course of their scientific training that intimate and detailed drill in the experimental work of elementary science and of descriptive geometry which is necessary in secondary school teaching. They may acquire this skill during their practice training as Referendare, or they may get it later in their actual experience as regular teachers. To supply this lack summer courses are offered at the universities and other institutions, for the benefit

of those actually engaged in teaching. The Staatliche Hauptstelle fuer Naturwissenschaftlichen Unterricht, in Berlin, is the Prussian organization under whose direction such courses are offered. I visited several of these in Berlin. In a course for teachers of zoology one was shown how drawings of animals could be perpared for class use quickly and cheaply. In this and in courses in inorganic chemistry, descriptive geometry, and physics, secondary-school teachers and "Assessoren" were actually performing, under the direction of experienced men, experiments appropriate for secondary schools, much as is done, at our universities, in summer courses for teachers. There were also courses of lecture in didactics.

The experimental work in these courses was done with crude, sometimes homemade apparatus; and the accommodations in other respects were meager. This was necessitated by lack of funds, due to that widespread poverty which, since the war, has acted like a blighting handicap in German educational undertakings. University and school men cannot afford to buy books, or even the scientific magazines so necessary to keep them abreast of progress; libraries cannot make their needful purchases; many school children are unable to buy the prescribed books; laboratories are short of supplies. In spite of such disabilities, perhaps because of them, there is a close-knitting bond uniting all the school agencies, and a spirit of coöperation between the community and the schools, which enables them to carry on and do admirable work.

TO OUR HIGH SCHOOLS

We frequently hear superintendents and principals of our high schools say that their best graduates of the year did not go to college, but that they were induced by business men of the community to enter some form of commercial activity. This we always regret to hear. The colleges and universities need the intellectual elite, the choice spirits, as well as the business world. Let us hope that some day opportunities will be so much greater for the college graduate that our high-school students will not be induced to step aside, at such an early age, in their educational progress.

College entrance requirements and the work of the first year of the college or university have been at about the same level for many years, and will likely remain the same in the years to come. The decrease in the amount of mathematics given in some of our high schools has produced a gap between the high school and college. Many students coming to the University are unable to bridge that gap and hence fail. The high-school diploma admits the pupil to college, but is no guarantee that he can do the work of the first year. Each student going to college should be advised in no uncertain way when his preparation is insufficient. It is only fair to him that he should be so informed. It would often save much disappointment and many heartaches and tears. In addition to the regular work of the high school, it would be well to give occasionally college entrance tests to those looking forward to a college career.

The Engineering Faculty of the University of Texas wishes us to announce to teachers and pupils of the high schools that hereafter all students entering the College of Engineering will be required to present solid geometry as an entrance requirement. Those who do not offer solid geometry will be required to take the subject without credit, after entrance.

There seems to be, at present, a gross misconception on the part of many high-school students as to the meaning and purpose of college life. They hear much of athletics, dances, and parades, but not enough of the real earnest work that should be characteristic of every successful student. Under such false notions, they begin in the wrong attitude toward their classes and very often fail before they awake to the fact that college life is a more serious affair and is made up of long hours of strenuous earnest work. Before entering college many of them have never learned what it is all about. They have heard of the pleasant side of college life. Some go because their friends have gone or for some other trivial reason, and often become college students more by accident than through any real purpose.

For the benefit of prospective college students, it would be well if a class or club should be formed in order that the teachers of the high school may discuss with such students certain topics of vital interest. The correct viewpoint given at this time will be of great value in what they are to do later. Topics of the following type are suggested:

(a) The aims and ambitions of each student.

(b) How a college career would aid in reaching such ideals.

(c) Discuss the preparation needed for college entrance.

(d) Discuss the work of the first year—the critical year of college life.

(e) Why so many fail and how to prevent failure.

(f) Many students are too immature for college entrance and should be advised to remain another year in the high school.

(g) Discuss with each student his deficiency in preparation.

(h) The mere fact that a high-school diploma admits one to college is no guarantee that he can do the work of the first year.

AN OPEN LETTER

To the Teachers of Mathematics in the High Schools and Junior High Schools in the State of Texas:

I desire very much your opinion in regard to the following points:

(1) To what extent should a teacher of mathematics in assigning the next lesson assist the student in the preparation of that lesson?

(2) To what extent should the initiative of the student be relied upon in the preparation of that lesson?

(3) To what do you attribute the almost universal complaint of each higher grade that students are not familiar with the work passed in the lower grades?

I will consider it a personal favor to receive either briefly or at length the views of every teacher of mathematics in every high school, or junior high school, or even in the lower grades.

Sincerely,

MARY E. DECHERD.

University of Texas.